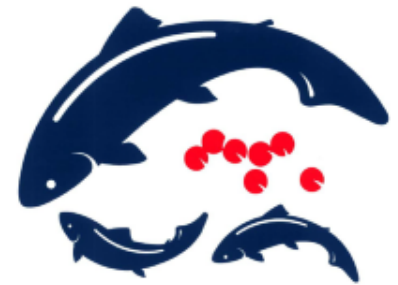


# Direct Stream versus acclimated releases of spring Chinook Salmon in the Imnaha River

Ethan Brandt  
Joseph Feldhaus



This project was funded by the United States Fish and Wildlife Service's Lower Snake River Compensation Plan



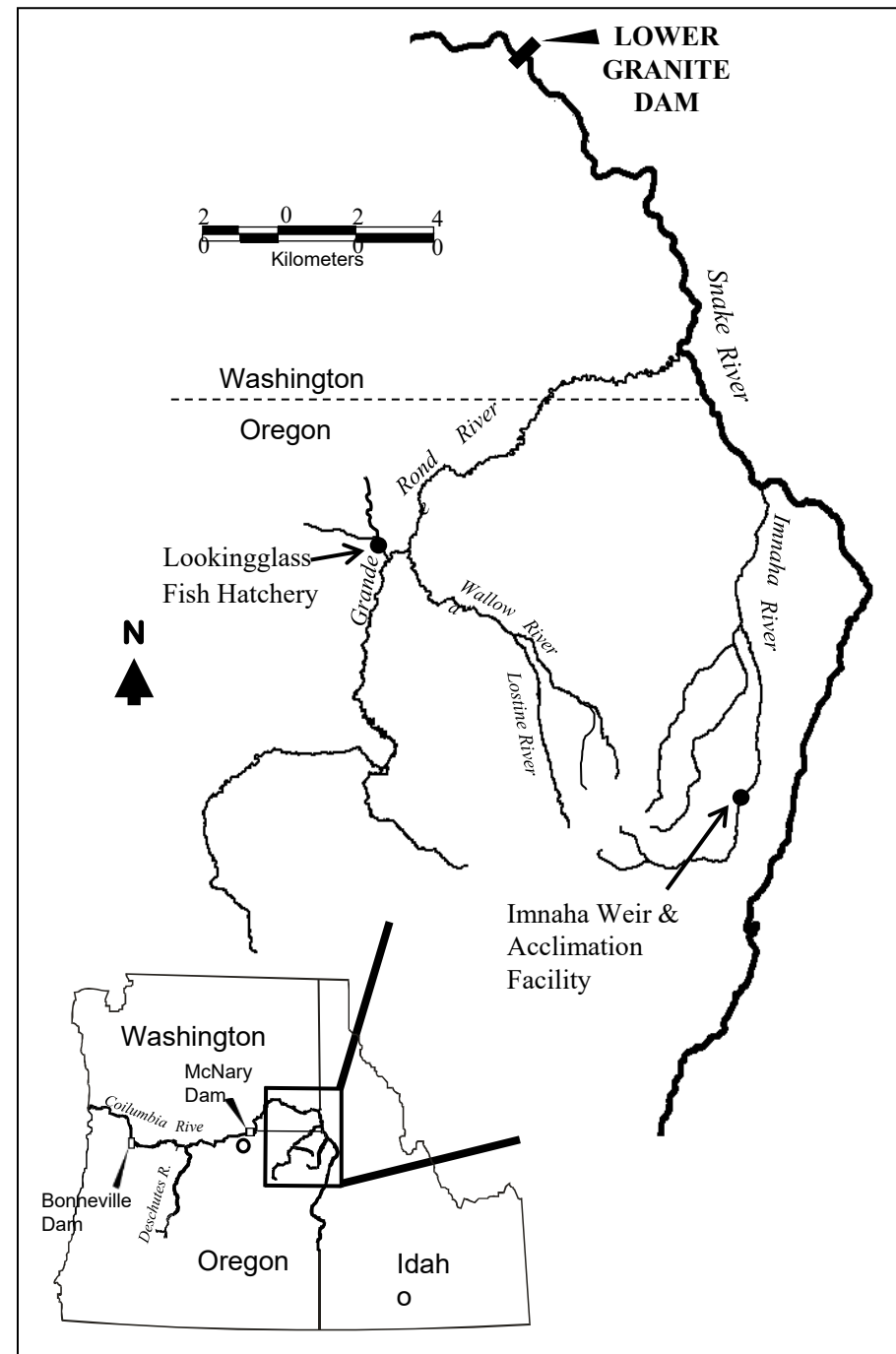
LOWER SNAKE RIVER  
COMPENSATION PLAN  
*Hatchery Program*



# Presentation Outline

- Study Design and Evaluation Area
  - 1) Goal: Evaluate Acclimated and Direct Stream release strategies for Imnaha River Hatchery Chinook Salmon smolts.
    - Better release strategy?
    - Spread the risk
  - 2) 5 Brood years (BY): 2010-2014 – original evaluation period
    - 3 Additional BYs 2015-2017 continued to both acclimate and direct release smolts
- Statistics
  - 1) Treatments: Direct and Acclimated
  - 2) Experimental unit = raceway
  - 3) Mixed effects model: Response Variable  $\sim$  Brood Year + Release Strategy.
    - Brood Year = Random Effect
- Juvenile metrics
  - 1) Weight (g) at release
  - 2) Survival rates from the release site to Lower Granite Dam (LGD)
  - 3) Distribution/arrival time of juveniles at LGD
- Adult return metrics
  - 1) Smolt-to-adult survival (SAS) rates (Ages 3-5)
  - 2) Age at maturity
  - 3) Stray rates

# Juvenile & Adult metrics



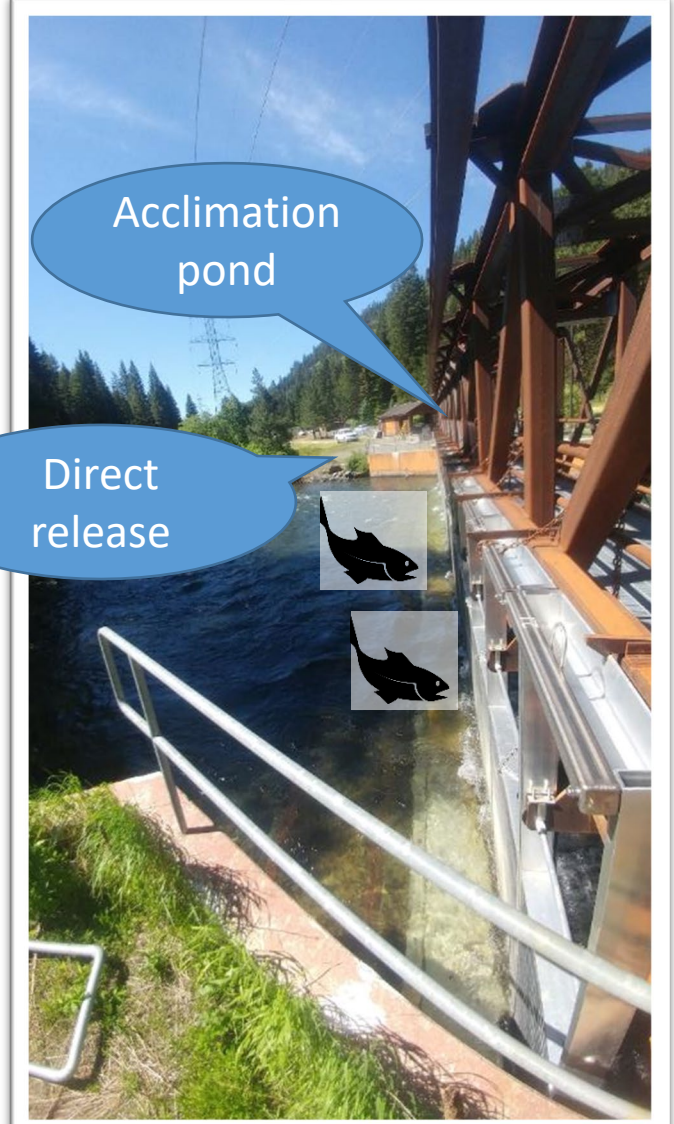
# Imnaha River Acclimation Facility



Transfer into the Acclimation pond



~ 2-week acclimation +  
~ 1-week volitional



Direct stream release

# Study Design

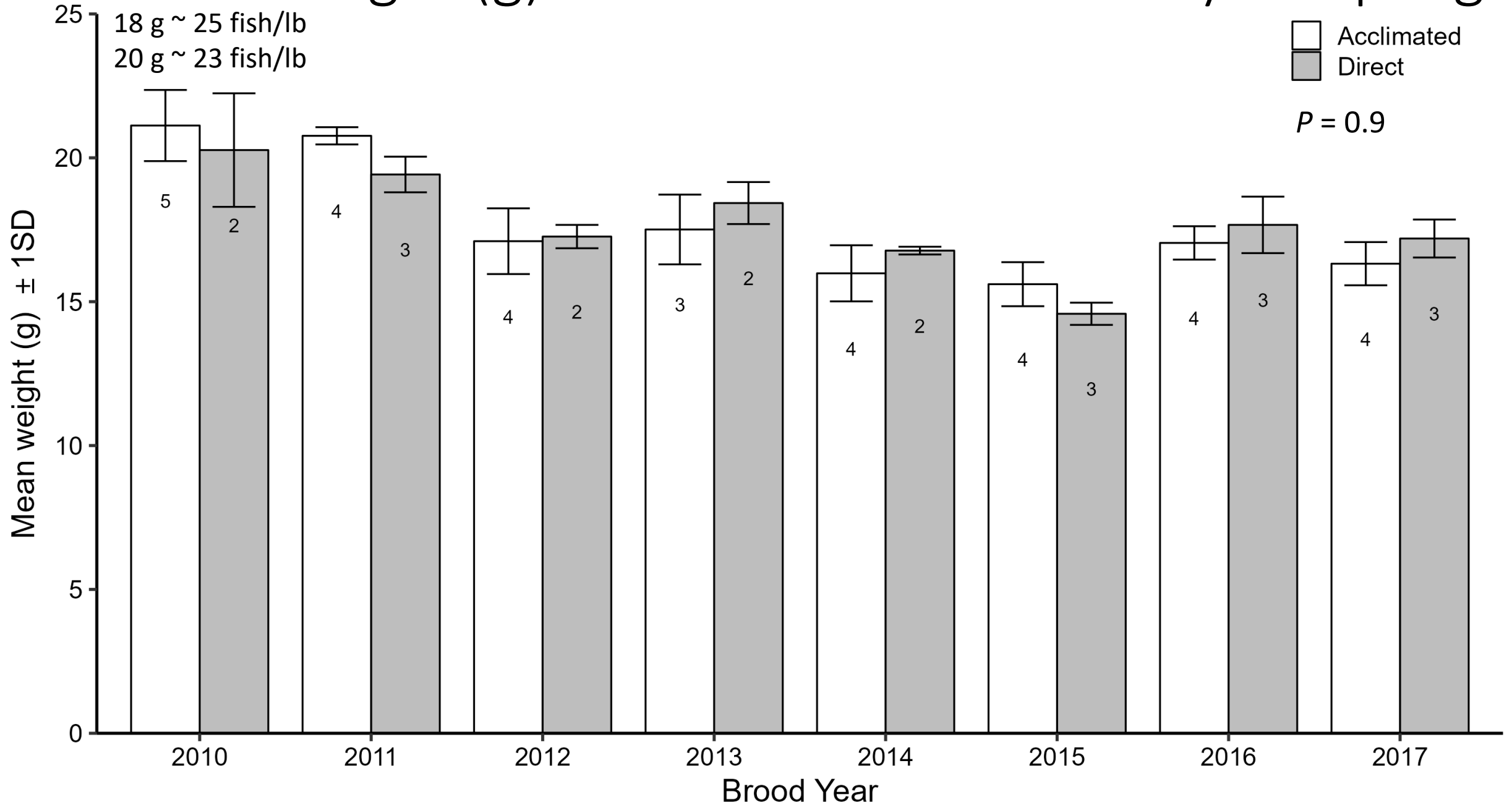
## Acclimated vs Direct Stream: Imnaha River BY2010-2017

Brood Year <sup>a</sup>	Last return year	Acclimated # of Raceways		Direct Stream # of Raceways		Smolt Release Metrics			
		AD CWT	AD	AD CWT	AD	Total Raceways	Total smolts	CWT smolts	# PIT tags
<b>2010</b>	2015	2	3	2	0	7	469,807	253,635	20,819
<b>2011</b>	2016	2	2	2	1	7	390,703	220,089	20,896
<b>2012</b>	2017	2	2	2	0	6	346,702	223,570	20,816
<b>2013</b>	2018	3	0	1	1	5	331,702	250,791	20,862
<b>2014</b>	2019	2	2	2	0	6	516,802	319,480	20,950
2015	2020	2	2	2	1	7	491,126	267,626	20,688
2016	2021	2	2	2	1	7	490,510	256,948	20,875
2017	2022	2	3	2	0	7	511,337	266,026	20,871

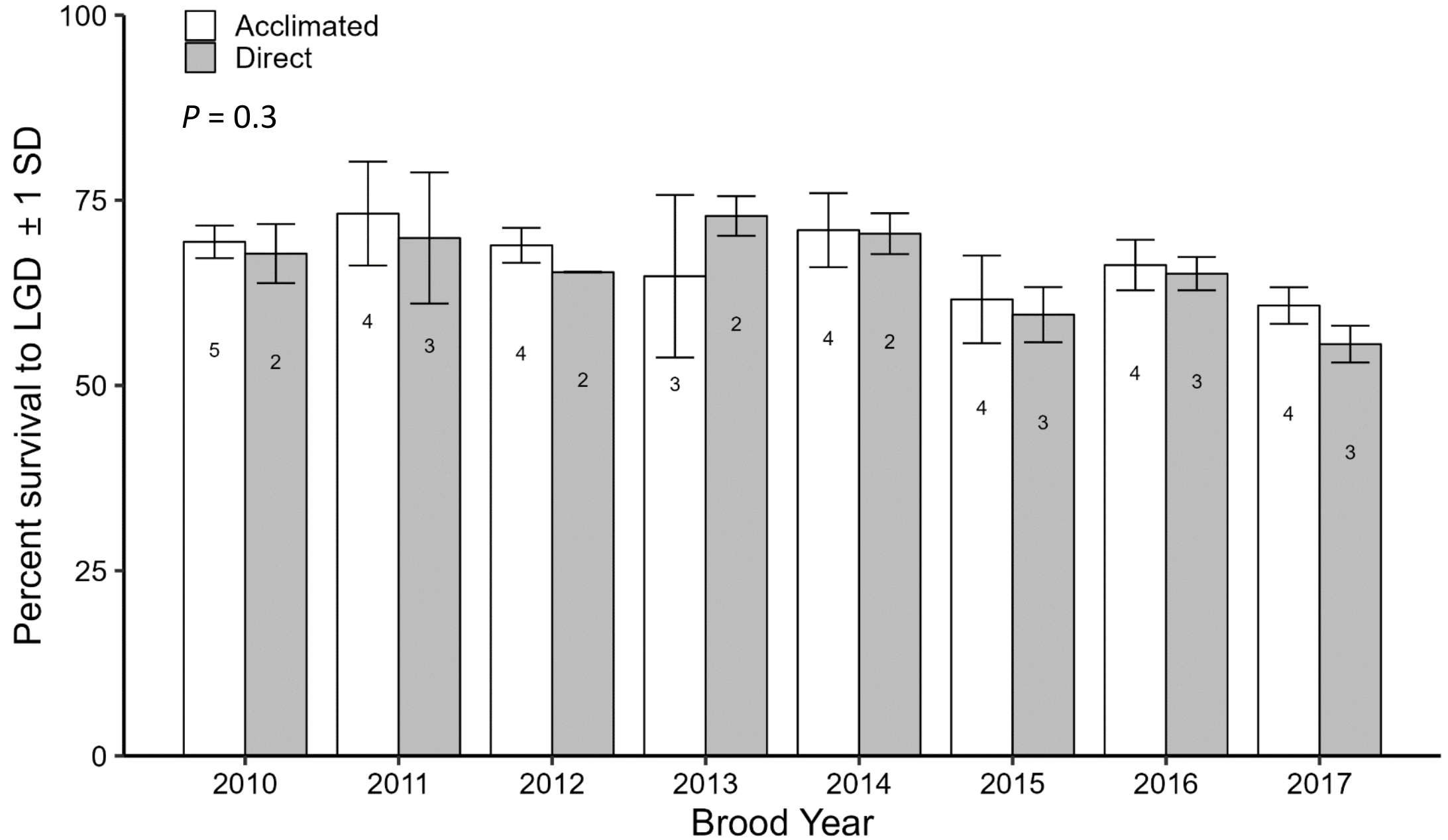
<sup>a</sup>Bolded and italicized years were part of the initial evaluation.

- AD CWT = Adipose fin clip + CWT (Goal was 100% AD & 100% CWT)
  - CWT marked 97.4% ± 2.6% (89.8–99.6%)
  - Ad clipped 98.4% ± 2.7% (89.7–99.8%)
  - Unmarked 0.4% ± 1.4% (0.2%–8.2%)
- PIT tags evenly distributed among raceways

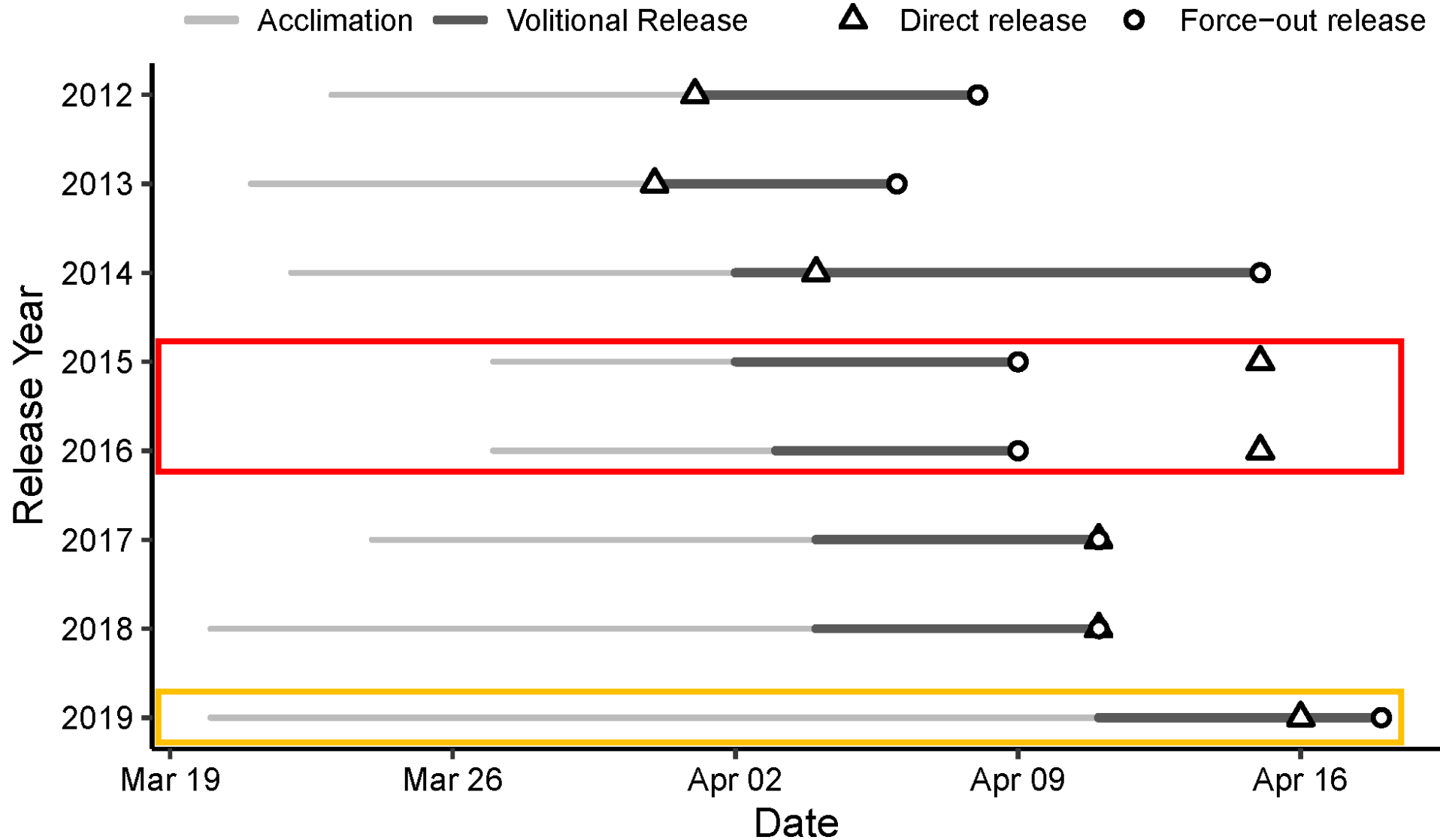
# Juvenile weight (g) at release from February sampling



# Juvenile Survival to Lower Granite Dam

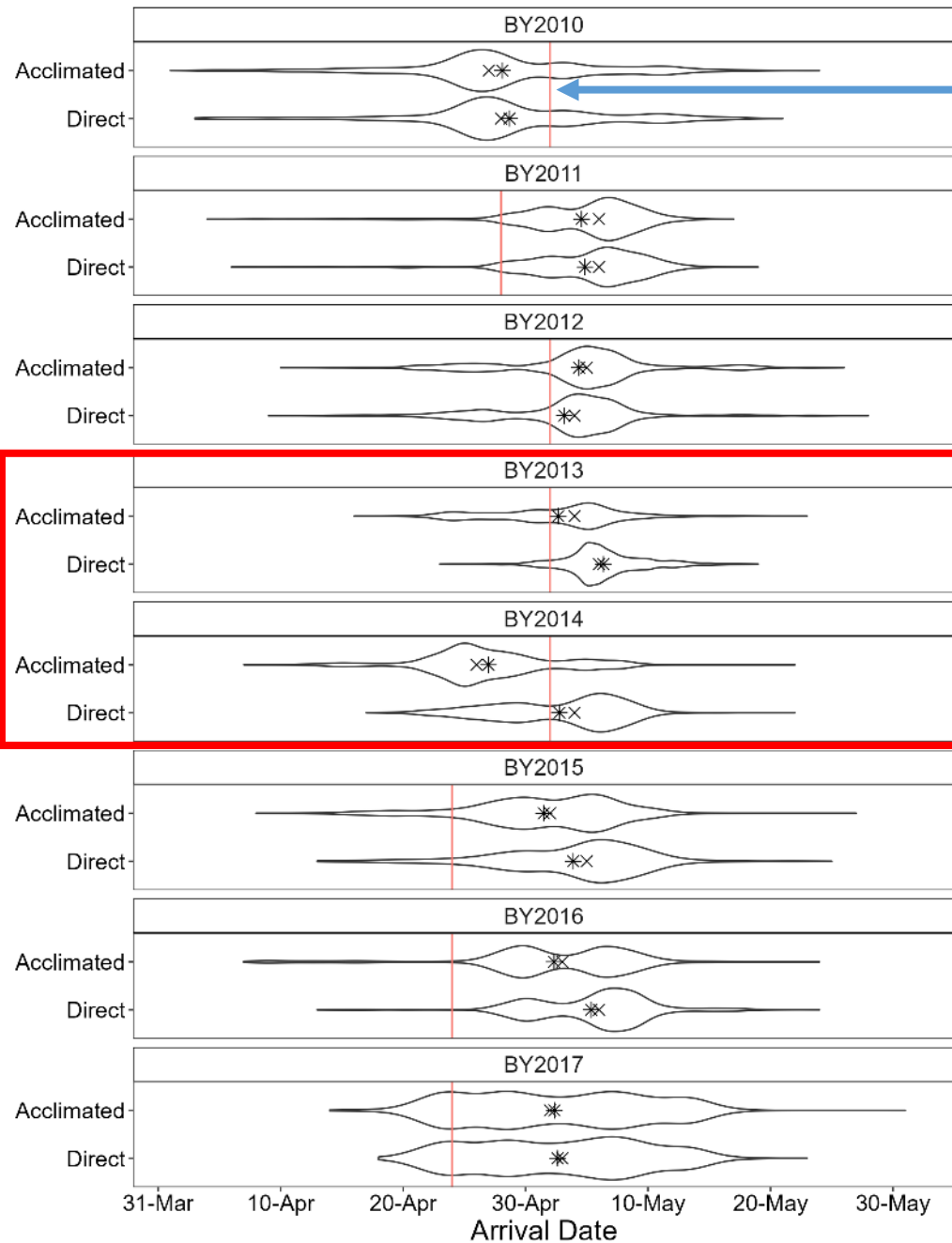


# Imnaha River Release Timing



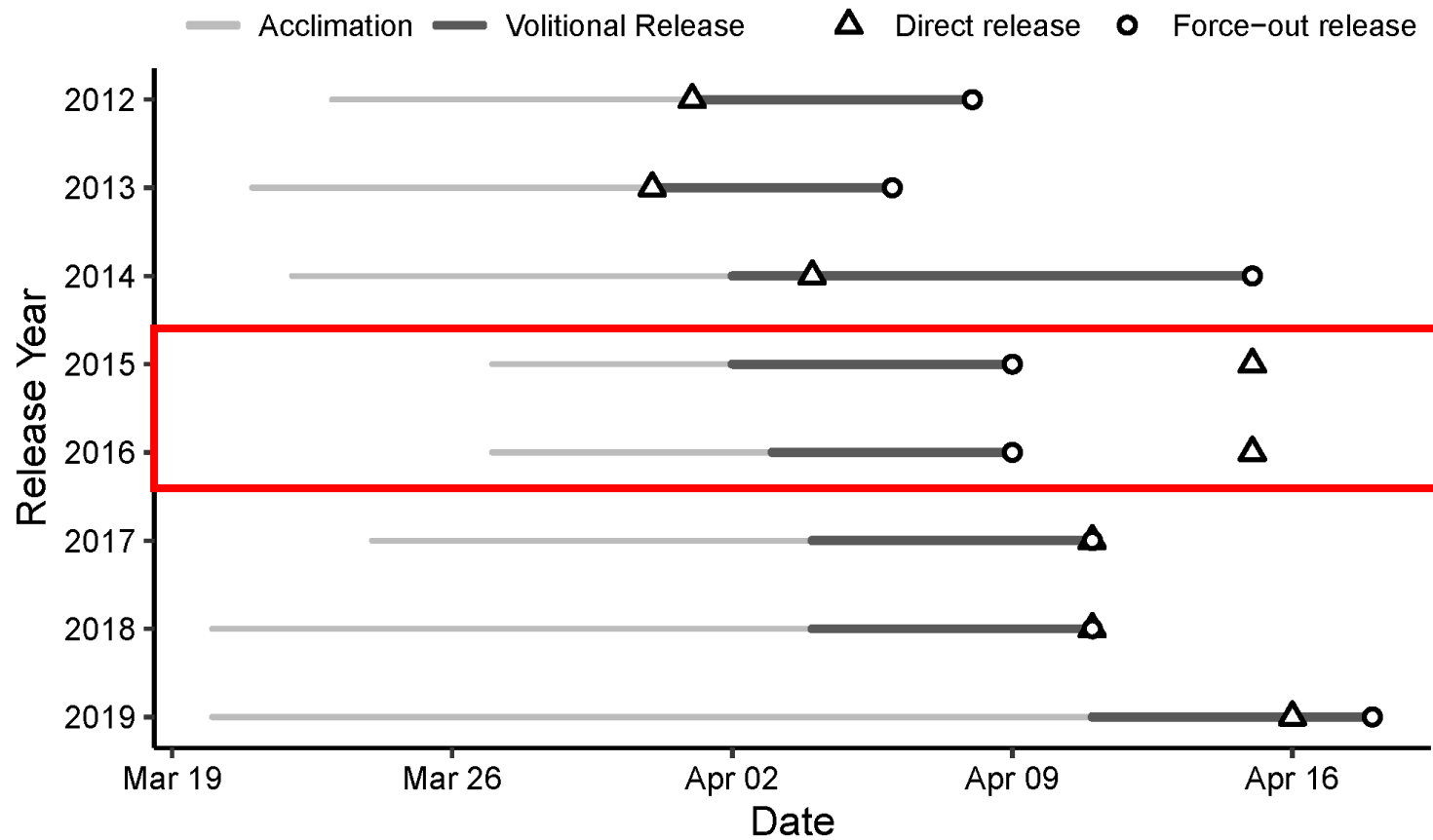


### Juvenile arrival date at Lower Granite Dam



Red line =  
Barging starts

### Imnaha River Release Timing

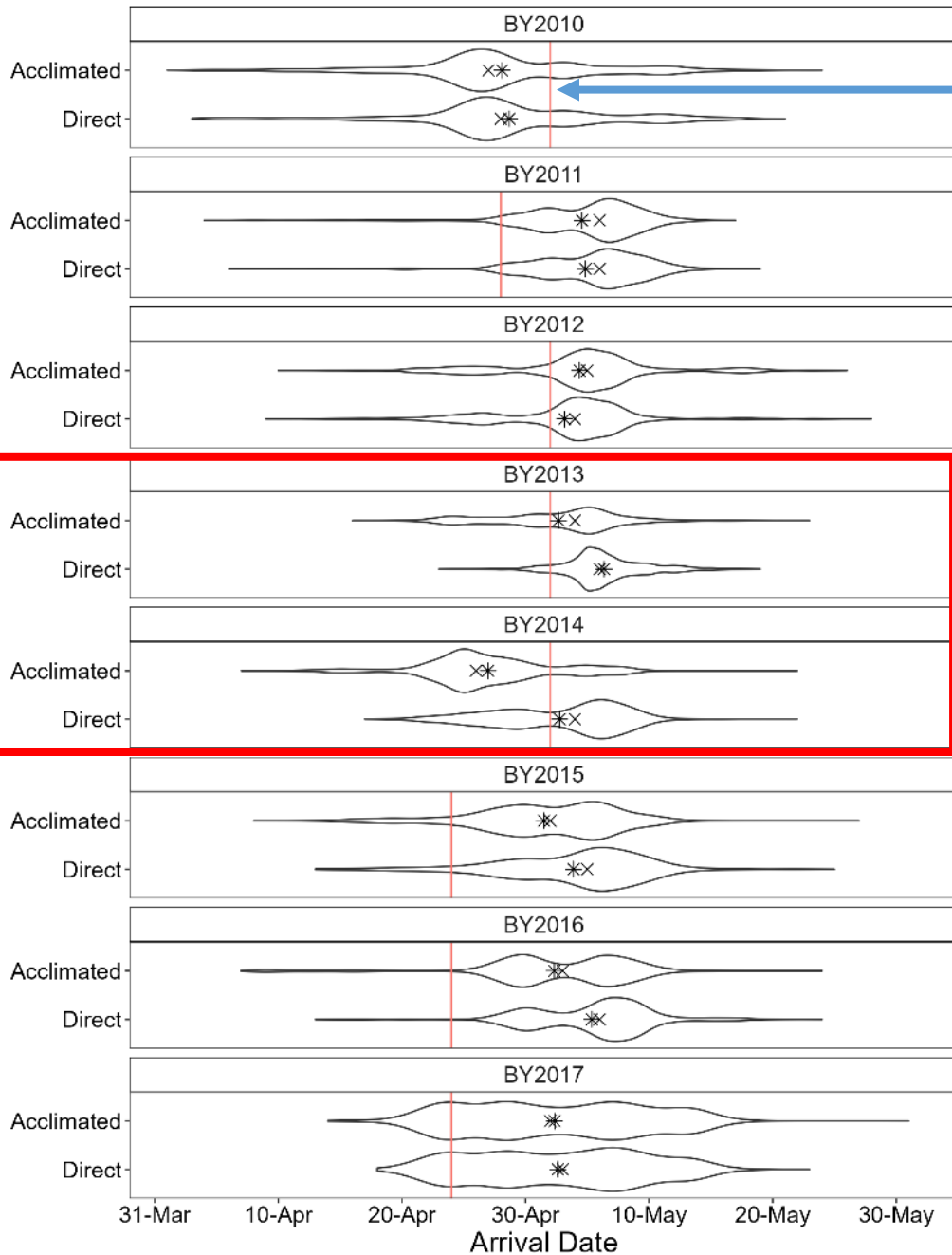


Release Strategy

Mean = \* Median = X

# Arrival distribution at Lower Granite Dam

## Juvenile arrival date at Lower Granite Dam

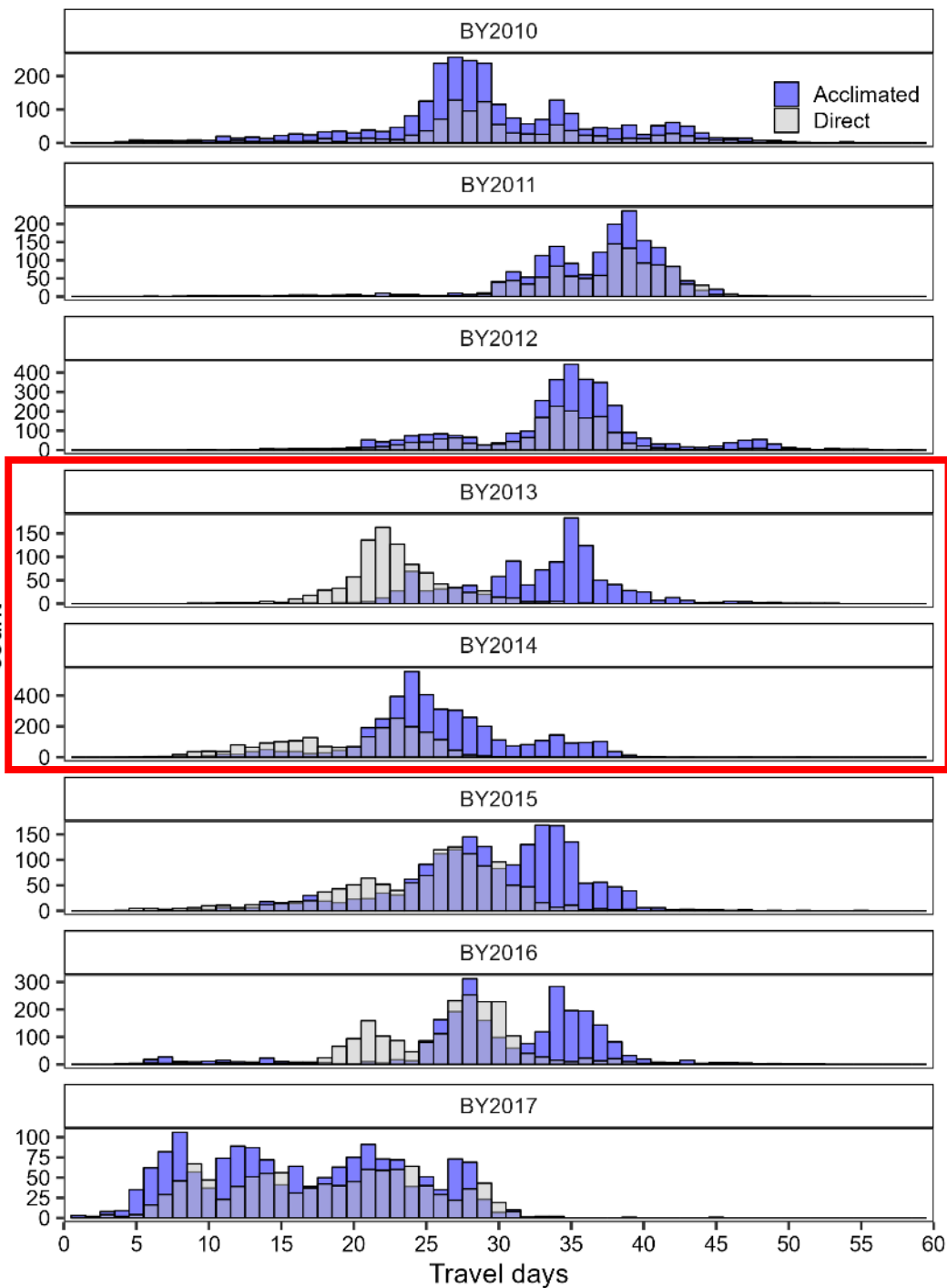


Red line =  
Barging starts

BY	Median travel days to LGD		Median Arrival Date @ LGD		Start Barging
	Accl.	Direct	Accl.	Direct	
2010	28	29	April 27	April 28	May 2
2011	38	38	May 7	May 7	April 28
2012	35	34	May 6	May 5	May 2
2013	34	22	May 5	May 7	May 2
2014	25	21	April 26	May 4	May 2
2015	30	26	May 3	May 6	April 24
2016	31	27	May 4	May 7	April 24
2017	16	18	May 3	May 4	April 24

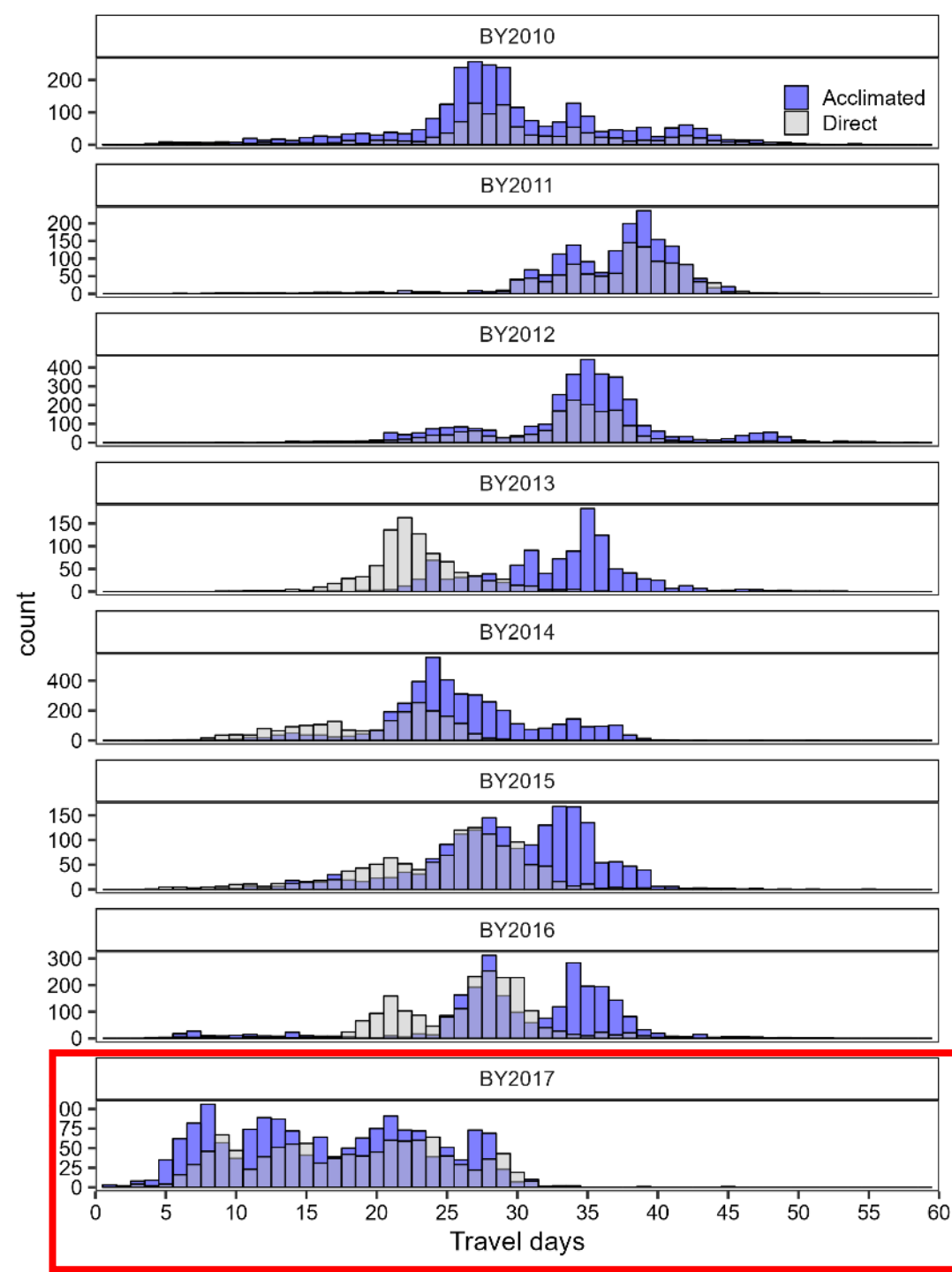
Mean = \* Median = X

# Arrival distribution at Lower Granite Dam



BY	Median travel days to LGD		Median Arrival Date @ LGD		Start Barging
	Accl.	Direct	Accl.	Direct	
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2013	34	22	May 5	May 7	May 2
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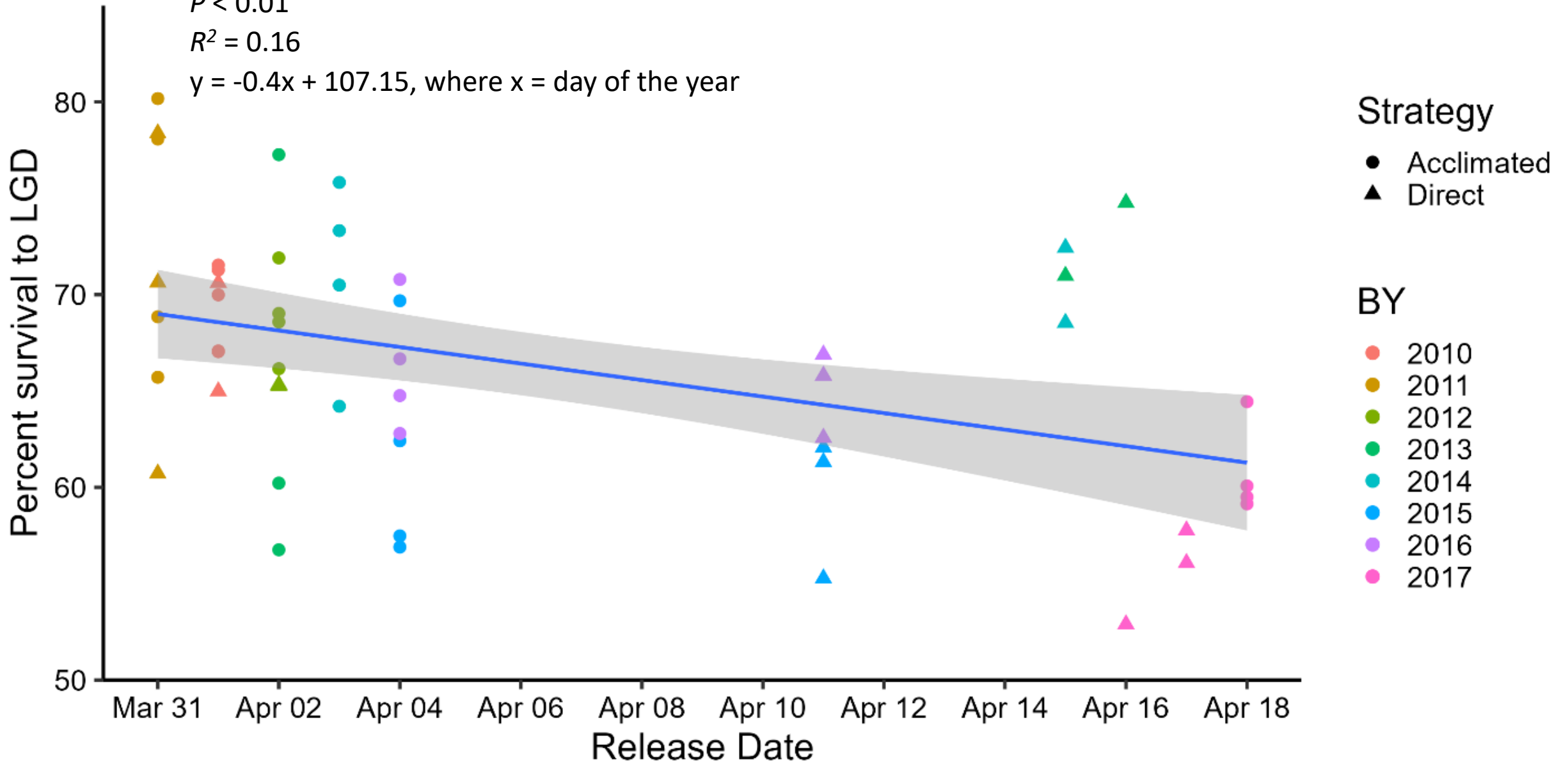
# Arrival distribution at Lower Granite Dam



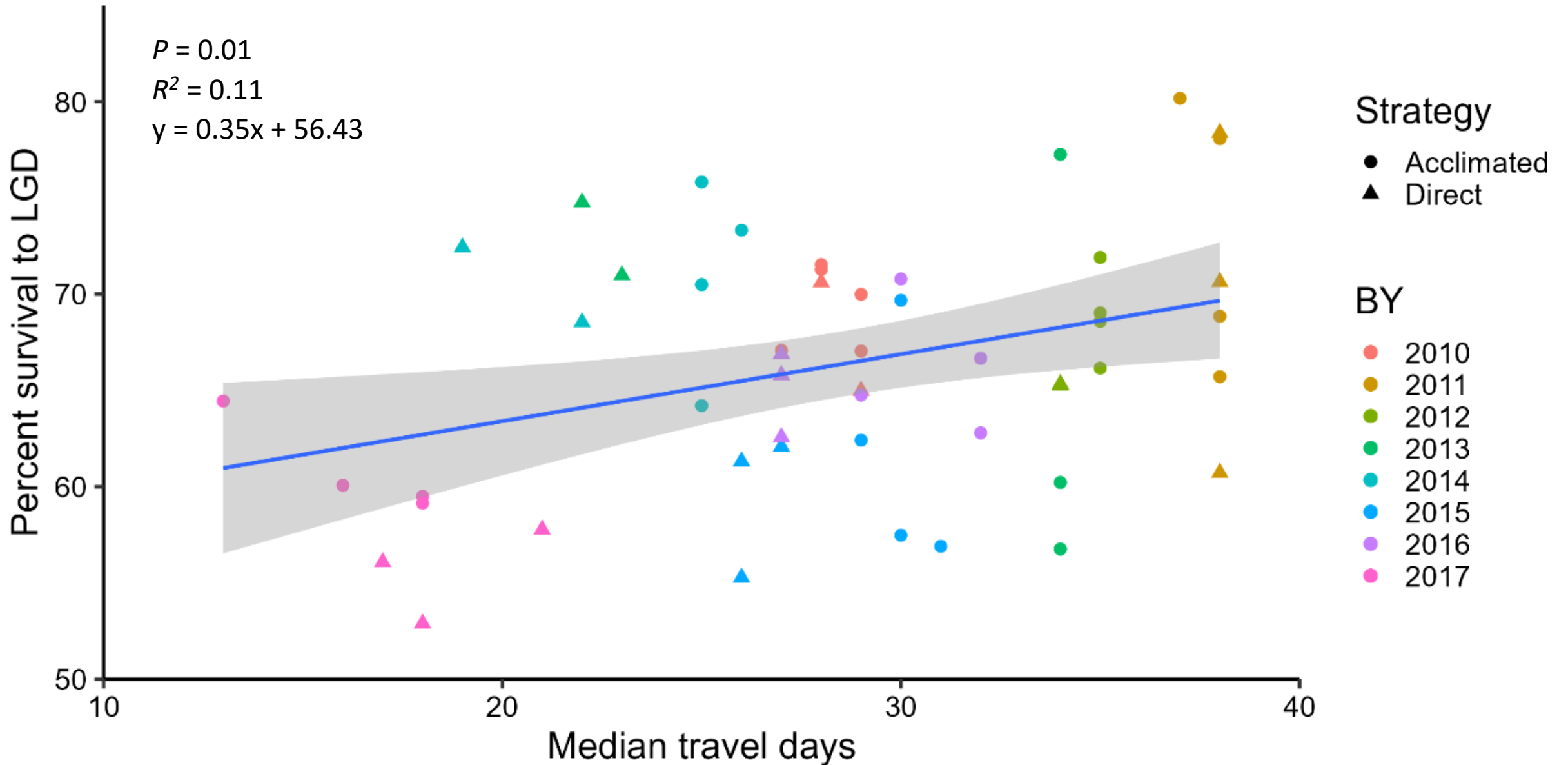
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2016	31	27	May 4	May 7	April 24
2017	16	18	May 3	May 4	April 24

# Juvenile Survival to Lower Granite vs Release Date

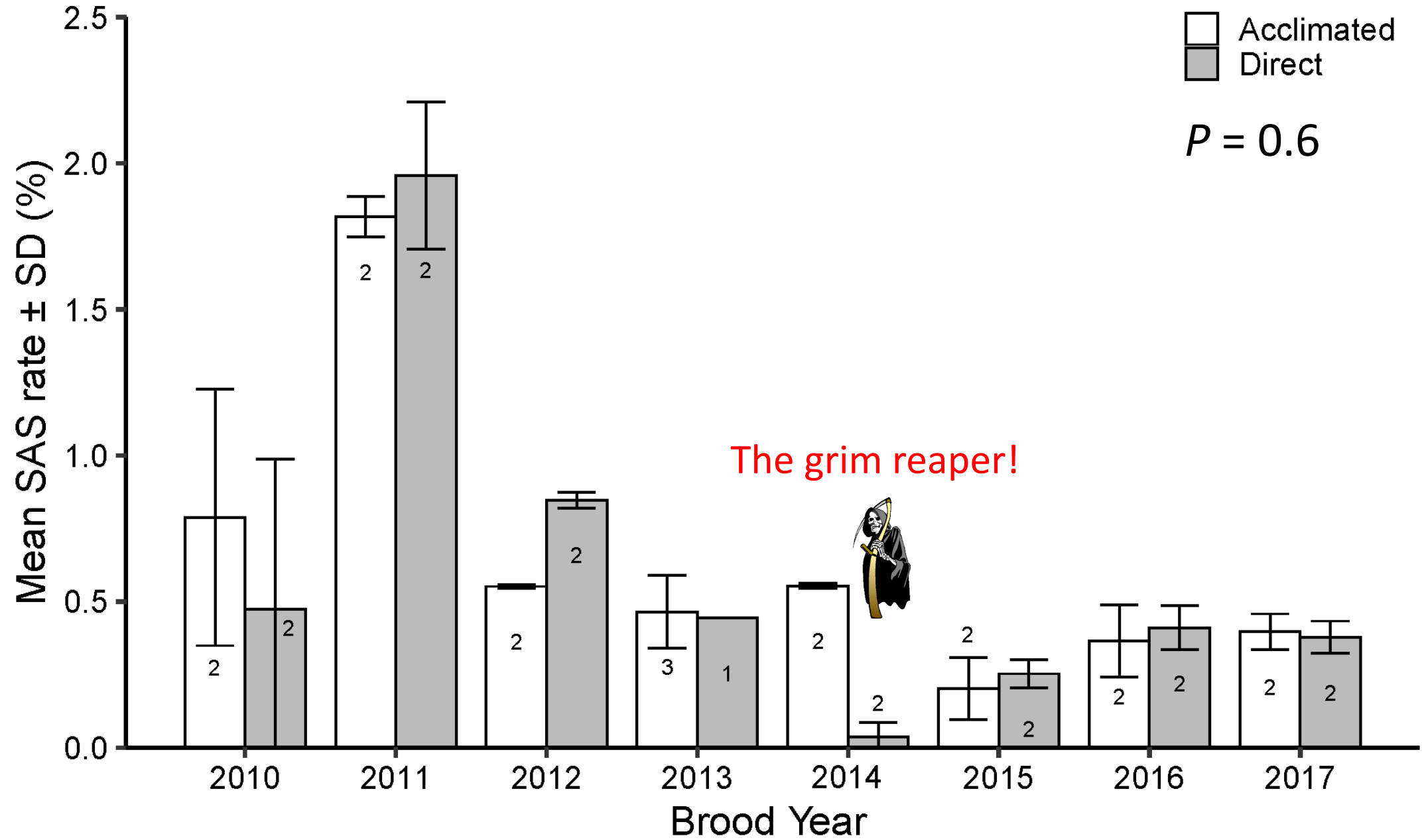
$P < 0.01$   
 $R^2 = 0.16$   
 $y = -0.4x + 107.15$ , where  $x = \text{day of the year}$



# Juvenile Survival to Lower Granite vs Median Travel days



# Smolt-to-Adult Survival (SAS) Rates (ADCWT)



# BY2014 & the “The Grim Reaper”!



- 100% of raceways = clinical levels of Bacterial Kidney Disease (BKD)
- **Raceway 9 (acclimated)** = 3x normal daily loss @ Lookingglass Fish Hatchery
- Fish Health findings from the Acclimation facility morts
  1. Clinical levels of BKD
  2. Infectious hematopoietic necrosis (IHN)
  3. Erythrocytic Inclusion Body Syndrome (EIBS)

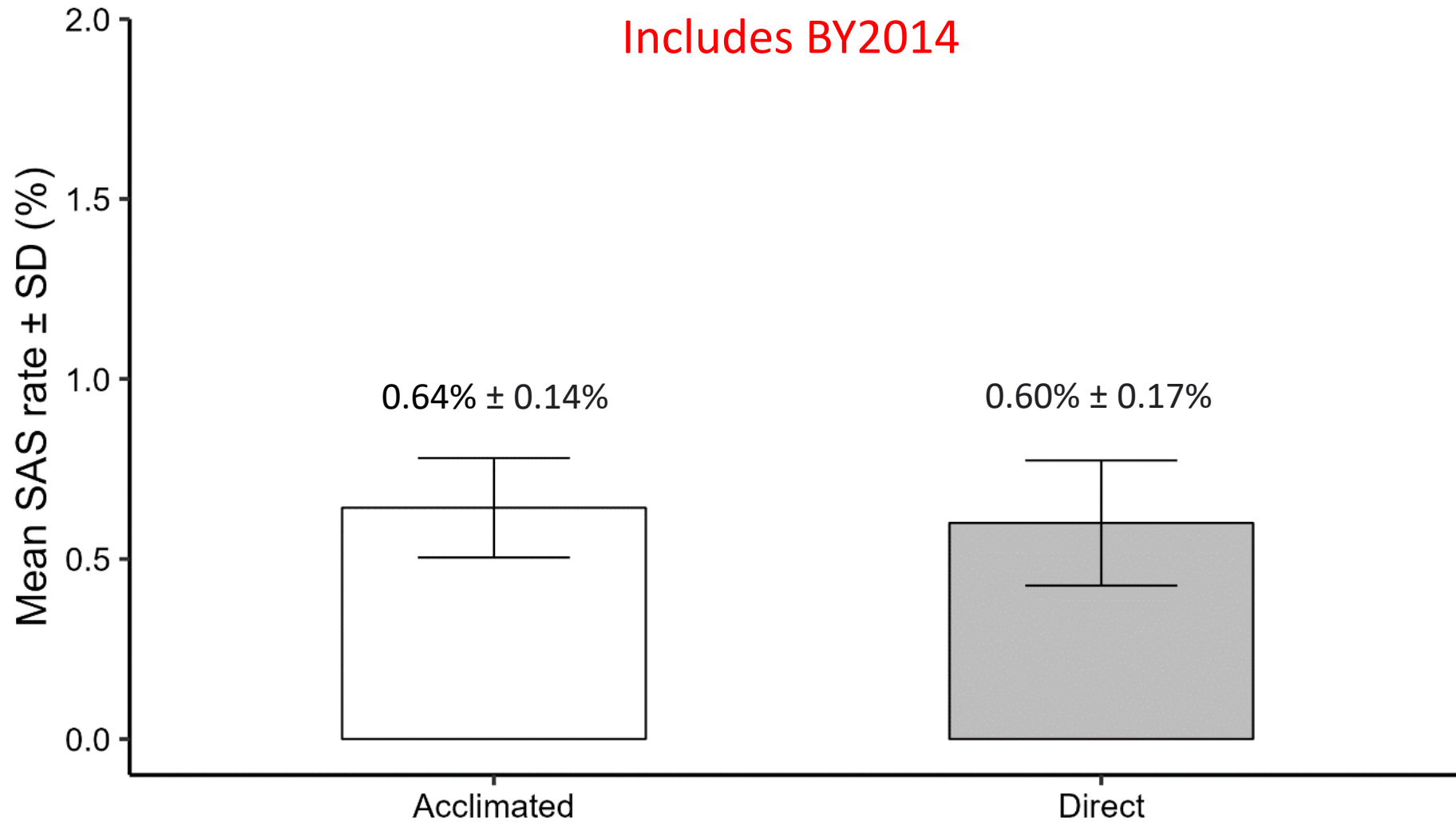


BY	Group	CWT Code	# of PIT tags	Total Smolts	Raceway	Number of PIT tags at Bonneville Dam				Total CWT recoveries (1/31/19)
						Age 3	Age 4	Age 5 2019 returns	Total PITs	
2014	Acclimated	090961	3,487	85,666	6	2	8	1	11	95
2014	Acclimated	090962	3,502	85,548	7	2	8	na	10	102
2014	Acclimated	Ad only	3,493	89,504	8	0	0	na	0	NA
2014	Acclimated	Ad only	3,495	88,147	9	0	0	na	0	NA
2014	Direct	090959	3,475	84,410	4	0	1	na	1	13
2014	Direct	090960	3,498	83,527	5	0	0	na	0	1 (ocean)
Mean			3,492	86,134						

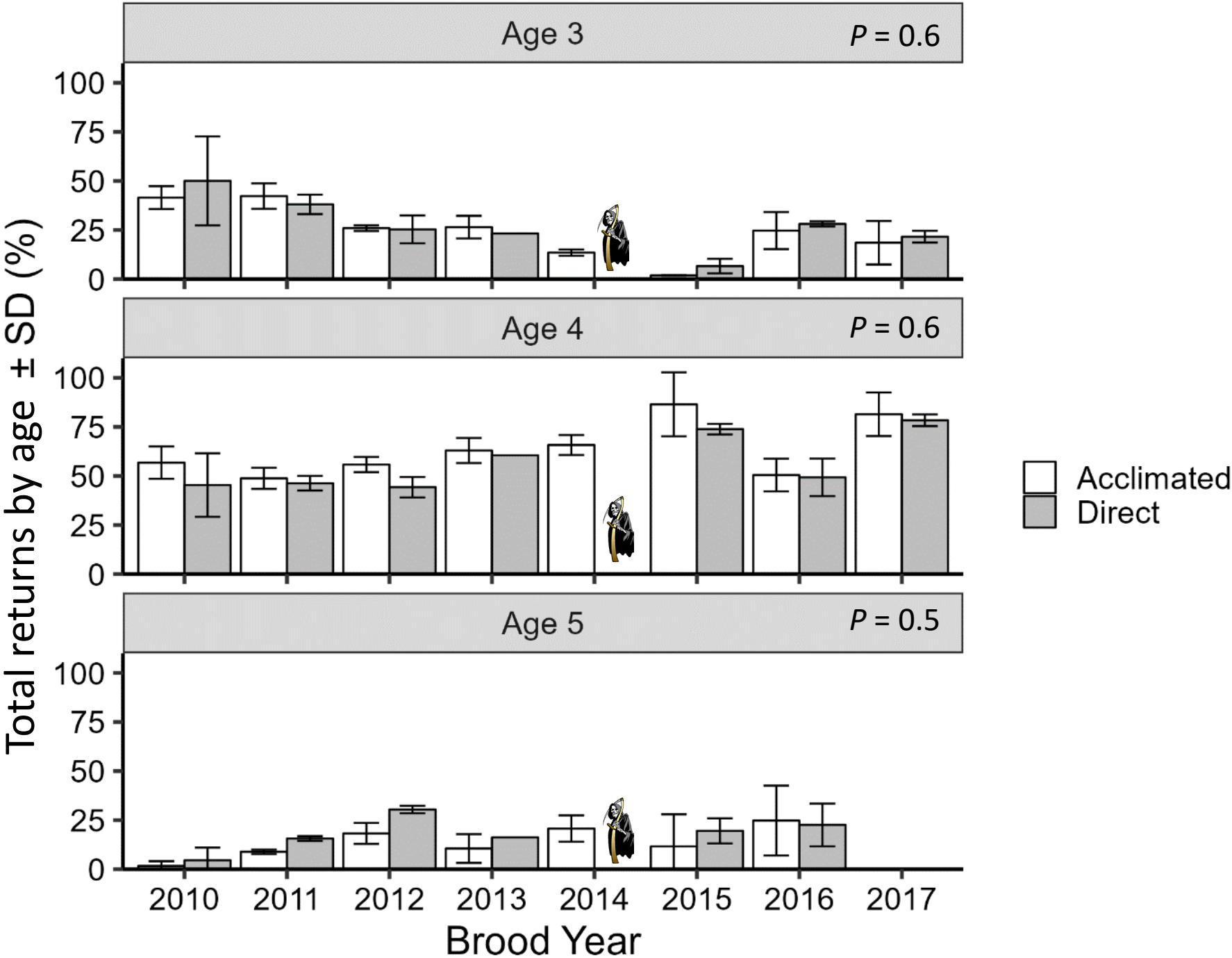




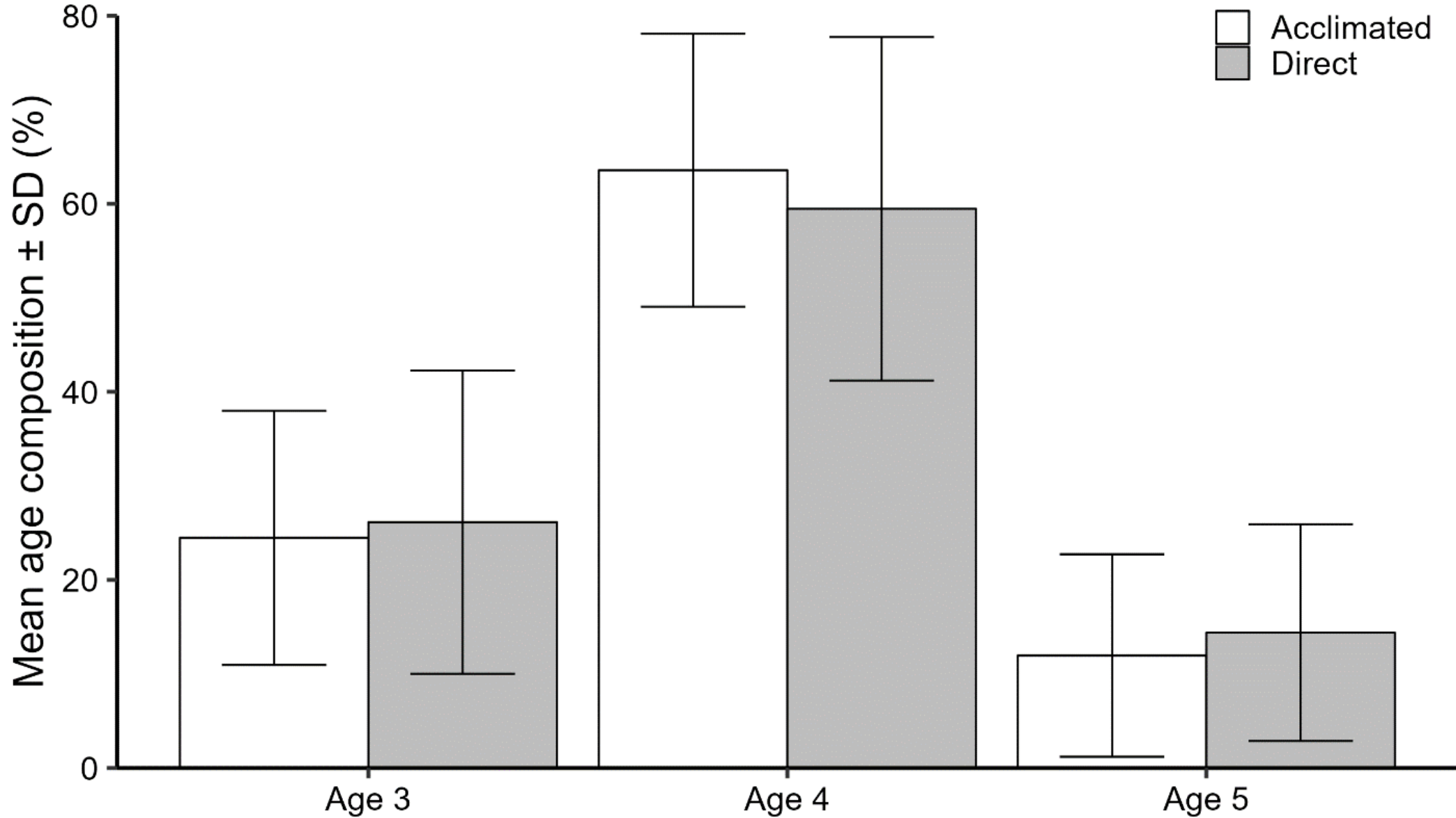
# Mean Smolt-to-Adult Survival (SAS) Rate ADCWT BY 2010–2017



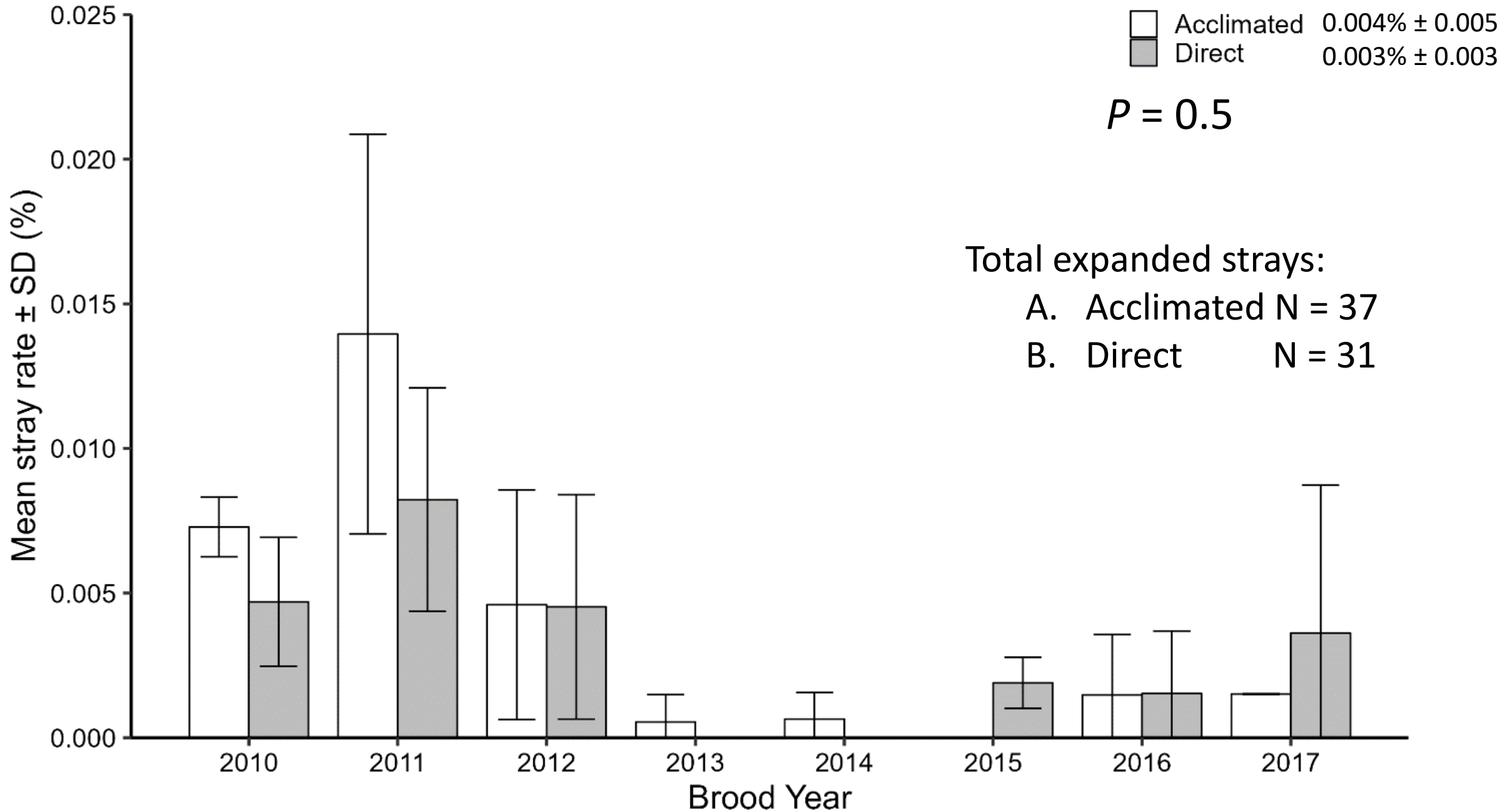
# SAS by Age at Maturity



# Mean Age Composition (ADCWT)



# Stray Rate (ADCWT)



# Summary: Direct vs Acclimated

## Juvenile metrics

- 1) Juvenile weight
- 2) Survival from the release site to Lower Granite Dam (LGD)
- 3) Distribution/arrival time of juveniles at LGD

- No significant difference ( $P = 0.9$ )
- No significant difference ( $P = 0.3$ )
- Release strategy affected arrival distribution/timing of smolts at LGD in 1 of 8 BYs.
- Arrival distribution/timing @ LGD influences migration strategy (e.g., barged vs run-of-the river.)

## Adult return metrics

1. Smolt-to-adult survival (SAS) rates (Ages 3-5)
2. Age at Maturity
3. Stray rates

- No significant differences:  $P = 0.6$
- No significant differences: (Age 4 > Age 3 > Age 5)
- No significant differences:
  - A. Acclimated (0.004%) > Direct (0.003%):  $P = 0.5$

The importance of raceway specific fish health monitoring



- BY14 = IHN, BKD & EIBS. Possible explanation for some raceways failing to return fish

Release timing and travel days

- Likely an earlier release date is better for survival

# Some parting thoughts



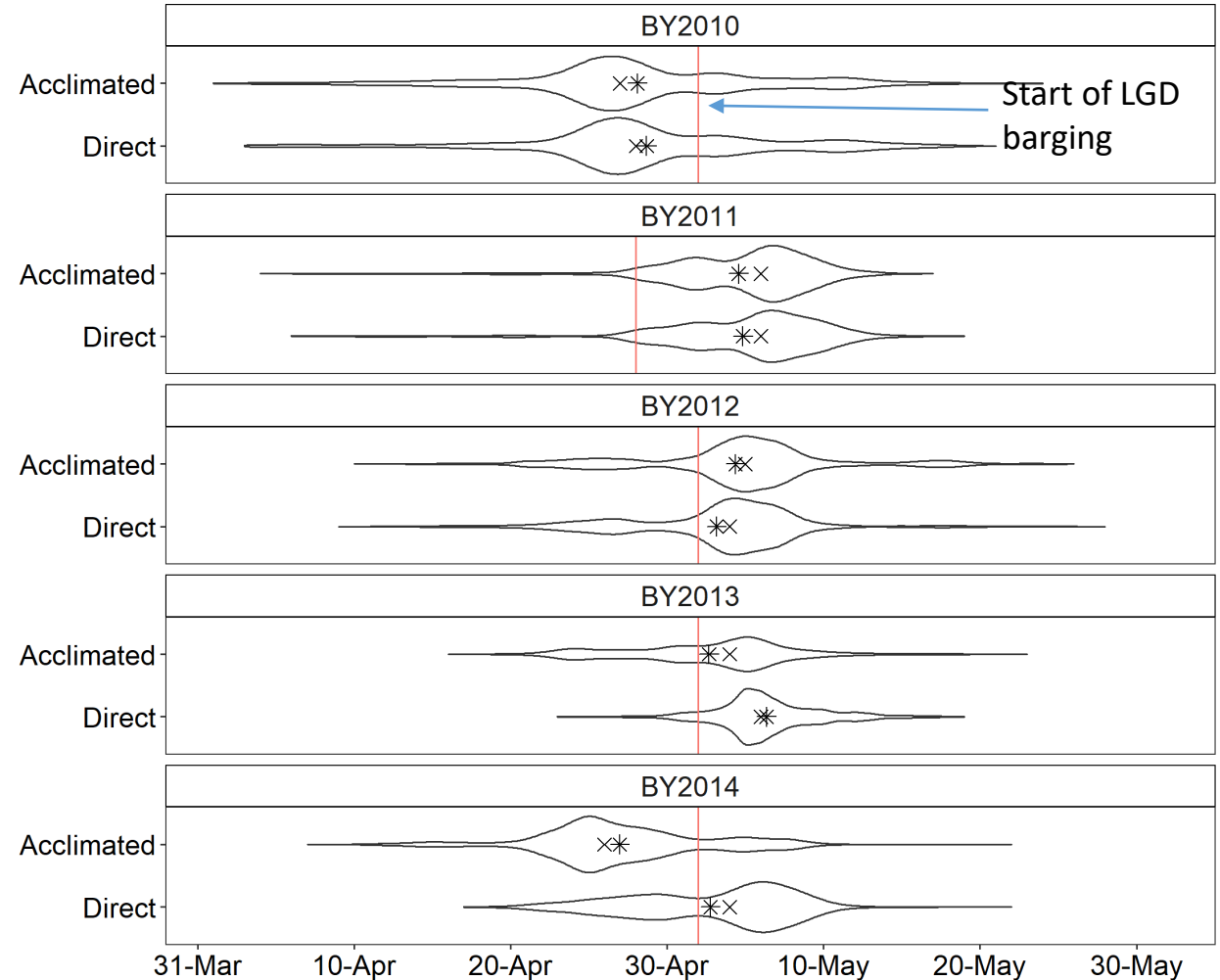
- Shorten acclimation and volitional release time periods?
- Median travel time to LGD for direct release >20 days. Is this equivalent to an acclimation period?
- Should juvenile releases be timed to coincide with barging?
- Consider how release strategies impact downriver screw trap operators.

Acclimation > Direct release

Lower Imnaha River screw trap



Photo credit = Lora Tenant (NPT)



Mean = \* Median = X

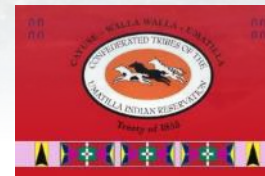
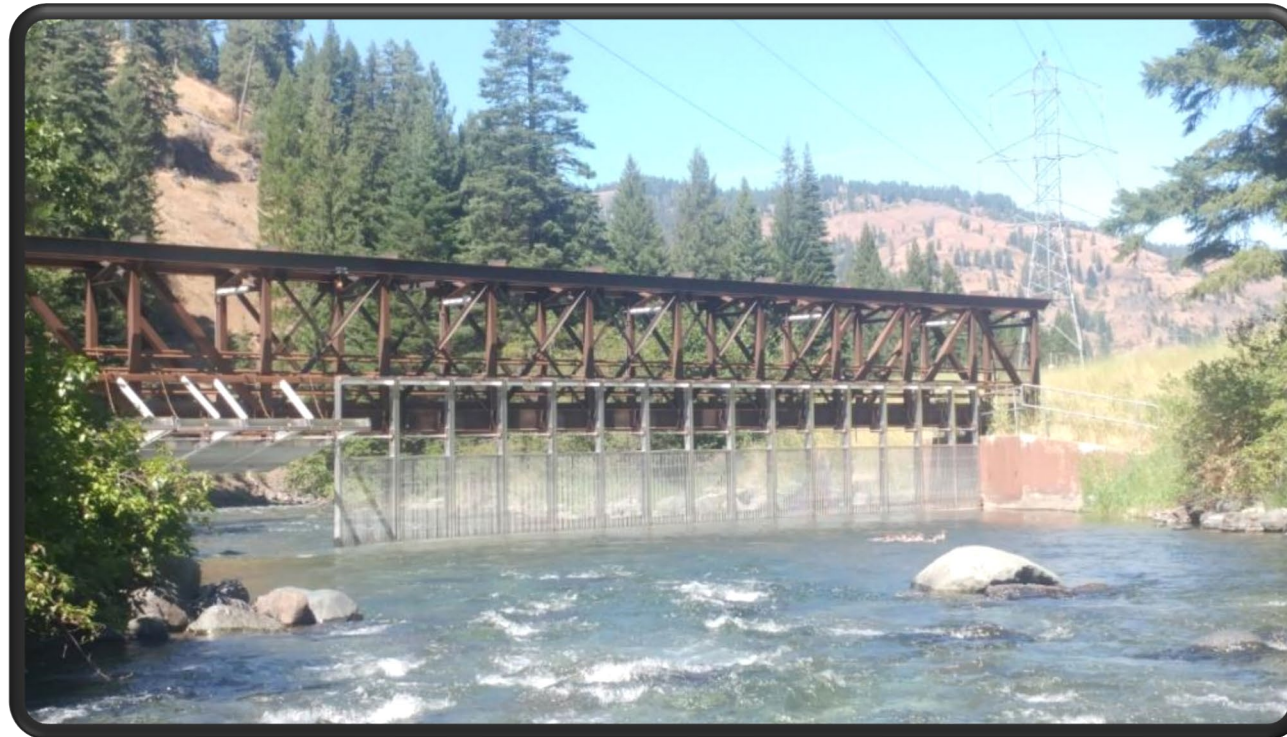


# Acknowledgements & Questions

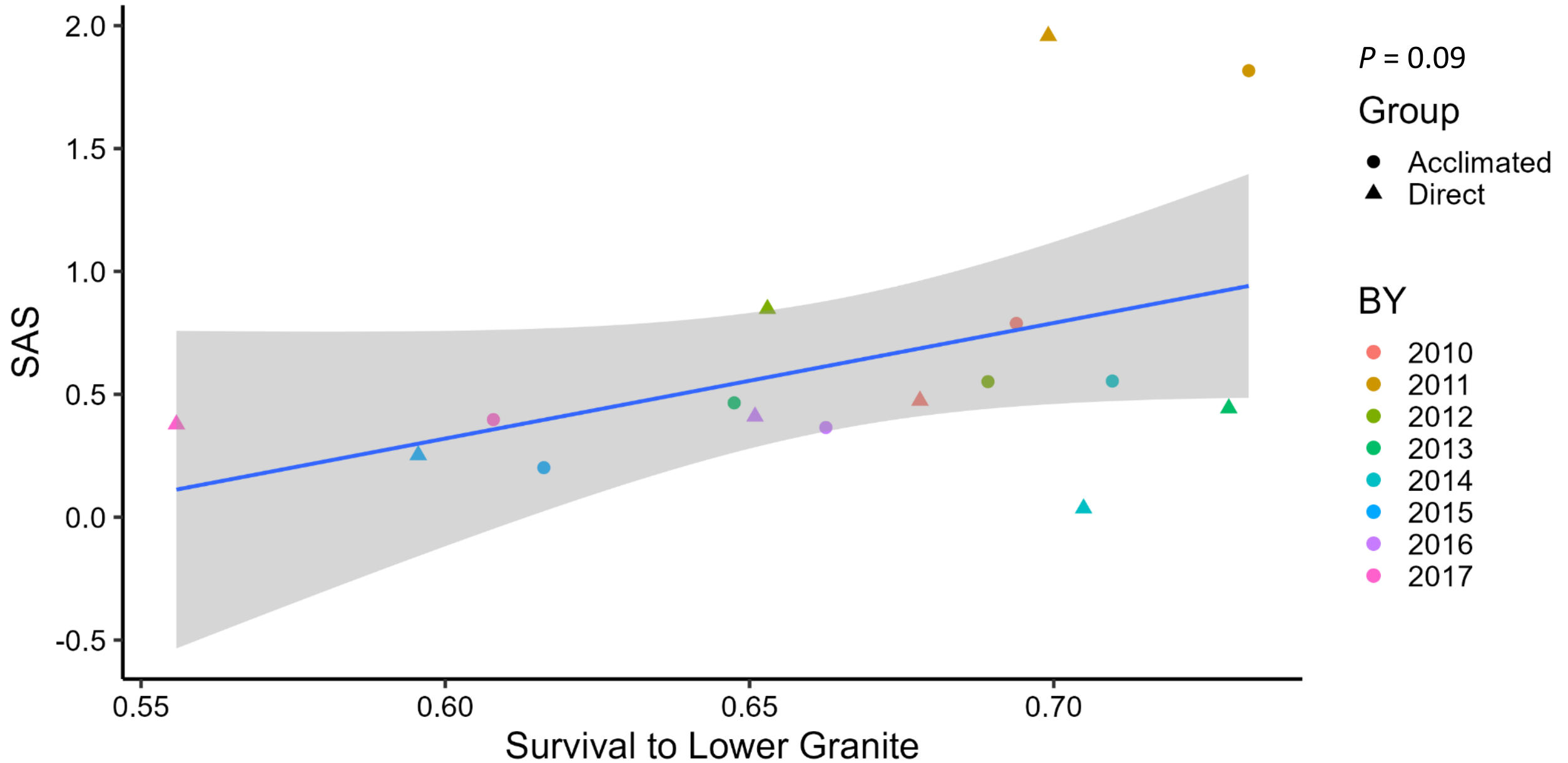
## Lookingglass Fish Hatchery



Sally Gee (ODFW)  
Shane Vatland (NPT)  
ODFW CWT Mark Lab



# SAS by Survival of Juvenile Smolts to Lower Granite Dam





# SAS by Median Travel Days of Juvenile Smolts to Lower Granite Dam

